CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD
SAN FRANCISCO BAY REGION

ORDER NO. 91-103

SITE CLEANUP REQUIREMENTS AND RESCISSION OF ORDER NO. 89-057 FOR:

TRW, INC., FEI MICROWAVE, INC., AND TECH FACILITY 1, INC.

FOR THE PROPERTY AT: **825 STEWART DRIVE**
SUNNYVALE
SANTA CLARA COUNTY

The California Regional Water Quality Control Board, San Francisco Bay Region (hereinafter called the Board) finds that:

1. Location and Facility Description This Order presents the results of the Remedial Investigation Report, Feasibility Study (RI/FS), and proposed final remedial action plan for the former TRW Microwave facility (TRW), 825 Stewart Drive Sunnyvale, Santa Clara County. This location is near the intersection of the Lawrence Expressway and Route 101 (see Appendix 1, Figure 1).

   This is an area of the Santa Clara Valley of low topographic relief. The drainage in the area is toward the north to San Francisco Bay. The facility is located in an industrial park setting dominated by low buildings separated by paved parking lots, fields and streets, with some landscaping. The dominant activity in this area is related to the semiconductor industry, though the industrial park is bordered by residential property particularly to the north.

   Initial operation as an industrial facility began in 1968 when Aerotech Industries began assembling and testing microwave components at this site. The first semiconductor manufacturing began in 1970. Aerotech Industries and this site were acquired by TRW Microwave in 1974 and was operated by TRW Microwave from July 1974 to August 1986. The property was purchased by Tech Facility 1, Inc. in 1987. Some assets at this site were acquired by FEI Microwave, Inc. in July 1987. The manufacturing facility is currently operated by FEI Microwave, Inc.

2. Site History While processes have varied throughout the history of the site, chemical usage has remained relatively constant. Solvents, metals, and acids have been involved in the manufacturing process. FEI Microwave is currently manufacturing electronic components at the facility.

   As a result of responses to an information questionnaire regarding underground tanks investigation of pollution at the 825 Stewart Drive site was initiated 1983 at the request of Board Staff. The initial phase of investigation produced evidence of soil pollution with a variety of volatile organic chemicals (VOCs). Investigation at the site has focused on the location of an underground solvent storage tank and acid neutralization system.

Additional soil work was completed in 1983 and initial groundwater investigation began in July 1983. In addition to VOCs, metals were detected in soil near the acid neutralization system. A more comprehensive soil investigation was completed in 1988 to address possible polluted soil that might still remain near the identified point sources (see Finding 7). All underground storage and treatment systems for solvents and acids have been removed and replaced with above ground systems.

Pursuant to the South Bay Multi-Site Cooperative Agreement (MSCA) and the South Bay Ground Water Contamination Enforcement Agreement, entered into on May 2, 1985 (as subsequently amended) by the Regional Board, EPA and DHS, the Regional Board has been acting as the lead regulatory agency. The Regional Board will continue to regulate the discharger's remediation and administer enforcement actions in accordance with CERCLA as amended by SARA.

The site has been included on the National Priorities List (NPL) and has been regulated by the Regional Board, as indicated herein:

a.	June 1984	Cleanup and Abatement Order Issued
b.	October 1985	Waste Discharge Requirements Adopted
c.	January 1988	Site Cleanup Requirements Adopted
d.	June 1988	Site proposed for inclusion on the National Priorities List (NPL).
e.	April 1989	Regional Board adopted Revised Site Cleanup Requirements.
f.	September 1989	Reissued Waste Discharge Requirements Adopted
g.	February 1990	Site formally added to the NPL

3. Scope and Role of Operable Unit Within Site Strategy For purposes of these reports and the proposed final remedial action plan the study area has been divided into four operable units (OU): AMD 901/902; Signetics Main Campus (811 East Arques and neighboring Signetics' facilities); the former TRW Microwave facility (825 Stewart Drive); and an offsite area north of Duane Avenue extending about 500 feet north of the Bayshore Freeway (Highway 101) and the Westinghouse facility south of Duane Avenue (see Appendix 1, Figure 2). The plumes have become commingled in the subsurface and the Offsite OU is necessary to include the extent of the groundwater pollution. These dischargers will be referred to collectively in this Tentative Order as "the Companies".

Proposed final Remedial Investigation and Feasibility Study (RI/FS) reports were submitted on behalf of the Companies in January 1991. Adoption of this Order will approve the joint RI/FS and a final Remedial Action Plan (RAP) that will encompass cleanup at the four operable units including AMD, Signetics, TRW Microwave and the offsite area.

The purpose of the final actions at the TRW OU (825 Stewart Drive) is to control the migration of polluted groundwater from the OU. The intent of actions set out in this Order is to expedite cleanup of groundwater at this OU and to prevent movement of polluted groundwater from this OU to other OUs and potential downward vertical migration into deeper aquifers that currently serve as drinking water sources.

The Offsite OU is the largest of the operable units. No known or suspected contaminant source areas are present in the Offsite OU. The purpose of remedial actions in the Offsite OU are to prevent further migration of contaminated groundwater.

4. Regulatory Status TRW, Inc., FEI Microwave, Inc. and Tech Facility 1, Inc. are hereinafter referred to as dischargers because of the releases of hazardous wastes that have occurred at this site. TRW, Inc., the parent corporation for TRW Microwave, has agreed to assume full responsibility to complete all necessary investigations and remedial action programs related to the subject property. Tech Facility 1, Inc. is the current owner of the property and FEI Microwave, Inc. is the current operator of the facility. All three parties are named as dischargers; however, Tech Facility 1, Inc. and FEI Microwave Inc. have responsibility for plume investigation and cleanup only in the event that TRW fails to comply with the requirements of this Board Order.

Separate Orders have been prepared for each onsite Operable Unit (AMD, Signetics and TRW) with joint tasks for the Offsite OU unit. This course has been taken due to the commingling of the groundwater plume in the offsite area. Joint Orders were not pursued because the properties are proposed as separate sites on the NPL. The Companies are encouraged to submit joint reports when feasible. If joint reports are not coordinated and submitted, each company is still individually responsible for the joint tasks in this Order. EPA is expected to agree with the selected remedy and issue a Record of Decision following adoption by the Board of a final Order approving the RI/FS and a final remedial action plan.

A search for potential responsible parties (PRPs) was completed for the Board by PRC, Inc. under contract to the Board. This search did not identify any other PRPs. 825 Stewart Drive is a site proposed for inclusion on the NPL and based on the above data TRW is also a Responsible Party under the Federal Superfund (CERCLA/SARA). Pursuant to Health and Safety Code Sections 25356.1 (c) and (d), these dischargers are the only identified responsible parties associated with the release of pollutants to the subsurface at this location and TRW has accepted responsibility for the cleanup at the TRW OU. In addition, as described in finding 4 above, TRW has accepted responsibility for jointly remediating groundwater pollution in the Offsite OU.

5. Remedial Investigation/Feasibility Study and Proposed Final Cleanup Plan The discharger submitted a Draft Final RI Report, February 1, 1991 and Draft Final FS Report January 15, 1991 which satisfies the requirements of Regional Board Order No. 89-57, Site Cleanup Requirements, adopted by the Board April 19, 1989. The FS report

includes a detailed screening of alternatives for soil and groundwater remedial actions, and a baseline risk assessment.

The final RI/FS was submitted in March 1991. The technical information contained in the RI/FS and the Proposed Plan Fact Sheet is consistent with the Health and Safety Code requirements for a final RAP and the National Contingency Plan requirements for a RI/FS. The RI/FS contains an evaluation of the interim remedial actions, an evaluation of final remedial alternatives, proposed remedial standards, and a recommended final remedial action plan.

6. Hydrogeology The sediments present surrounding the TRW OU were deposited by alluvial systems that carried sediment from the uplands to the south as the streams flowed north toward what is now San Francisco Bay. The materials present in the subsurface are interbedded sands, silts and clays. The finer grained materials are probably dominant with the more permeable, coarser grained units tending to be laterally discontinuous.

The nomenclature applied to the water bearing units in the study area is representative of the hydrogeology within the Santa Clara Groundwater Basin. A number of shallow water bearing units are separated from deeper aquifers by a thick persistent aquitard. The shallow units may be subdivided into a variety of zones depending upon depth, lithology and lateral persistence. These zones are frequently labeled as A and B zones. The deeper aquifer is commonly referred to as the C aquifer and the clay layer separating the upper and lower water-bearing zones is commonly referred to as the B-C aquitard. The aquitard has been reported to be between 50 and 100 feet thick in Santa Clara Valley.

Groundwater from this basin provides up to 50% of the municipal drinking water for the 1.4 million residents of the Santa Clara Valley. In 1989, groundwater accounted for approximately 128,000 of the 315,000 acre feet of drinking water delivered to Santa Clara Valley Water District customers. This water is produced from the C aquifer.

Six local groundwater aquifers have been identified at the TRW (FEI) facility. Regional investigation has indicated that deeper aquifers do exist in the Santa Clara Valley Groundwater Basin and are probably present in the project area. The shallowest water bearing zone has been designated the A zone and generally occurs from 6 to 25 feet below the ground surface. This is the most persistent, permeable unit near 825 Stewart Drive and generally contains from 1 to 19 feet of permeable material. The next unit has been designated as the B1 aquifer and generally occurs from 25 to 55 feet below ground surface and contains 0.5 to 15 feet of permeable materials. The next unit has been designated as the B2 aquifer and occurs from 45 to 55 feet below the ground surface. It generally contains from 6 to 8 feet of permeable material. The next unit, the B3, is relatively thin and only encountered in a few borings at the TRW site. It consists of from 1 to 5 feet of permeable material. The next unit, B4, begins from 82 to 86 feet below ground surface and contains 1 to 4 feet of permeable material. The deepest unit identified at the TRW site is aquifer

B5. This aquifer occurs from 116 to 123 feet below ground surface and contains 5 to 7 feet of permeable material.

The static groundwater flow direction at 825 Stewart Drive is to the north-northeast in all aquifers. The vertical gradient has been documented to be upward under normal conditions in the study area. The flow direction and vertical hydraulic gradient may be reversed locally in the vicinity of groundwater extraction wells operating in the A, B1 and B2 aquifers.

7. State Board Resolution 88-63 On March 30, 1989, the Regional Board incorporated the State Board Policy of "Sources of Drinking Water" into the Basin Plan. The policy provides for a Municipal and Domestic Supply designation for all waters of the State with some exceptions. Groundwaters of the State are considered to be suitable or potentially suitable for municipal or domestic supply with the exception of: 1) the total dissolved solids in the groundwater exceed 3000 mg/L, and 2) the water source does not provide sufficient water to supply a single well capable of producing an average, sustained yield of 200 gallons per day. Based on data submitted by TRW, the Board finds that, while the A zone would not under the current drought condition and the impact of long-term groundwater extraction support a well that would yield 200 gallons per day, TRW has not demonstrated that this would be true under normal conditions. Therefore, neither of these two exceptions apply to the A and B zones at TRW and Offsite OUs. Thus, the A and B zones are considered to be potential sources of drinking water.

8. Source Investigation Two possible sources of pollution have been identified at TRW. These include an acid neutralization system and an underground solvent storage tank area (see Appendix 1, Figure 3). Initial soil pollution investigations focused on the area near the underground solvent waste storage tank in 1983. Additional soil samples were collected in July of 1984; the soil in these samples contained a variety of VOCs including trichloroethylene (TCE), tetrachloroethylene (PCE), and 1,2-dichloroethylene (1,2-DCE). The waste solvent storage tank and some associated soil was removed in 1983. Additional soil removal was completed in 1984. The excavation was expanded to the limits allowed by the proximity of the building. This area was identified as a point source for chemicals that resulted in groundwater pollution.

Additional investigation was completed in 1988, as required under Order 88-015, since some contaminated soil was left in place near the former location of the underground waste solvent storage tank. The maximum concentration of total VOCs detected in the vadose zone near the solvent storage tank was about 4 ppm. The maximum concentration of total VOCs in saturated zone soil in this area was approximately 34 ppm. Based on these estimates, and making liberal assumptions regarding concentration and volume, it is estimated that the vadose and saturated soils in this area contain at most three pounds of TCE.

Soil investigation near an underground, acid neutralization system (ANS) was also carried out during the closure of the system in 1986. Some soil samples contained elevated levels of metals, however no elevated levels of VOCs were detected during this

investigation. This area is not considered a source area for pollutants currently detected in the groundwater. Extraction tests on soil from the ANS excavation area indicate that the inorganics would not be expected to impact groundwater.

9. Extent of Pollution The initial groundwater monitor wells were installed at this site by TRW in 1983, with additional wells installed in 1984 and 1986. The dominant VOC in the groundwater is TCE, although 1,2-DCE, Freon 113, and PCE are also frequently detected.

The highest initial levels of TCE in the groundwater were detected in well T-2A. The highest concentrations of VOCs in the A aquifer in 1990 were measured in groundwater from wells T-9A and T-7A (see Appendix 1, figure 4), with the most recent concentrations being approximately 2,300 and 1,700 µg/l, respectively. Contaminant concentrations in these wells may be influenced by migration from offsite sources. Therefore these wells may not be representative of A zone contamination at the TRW OU. Well T-2A (see Appendix 1, figure 4), an extraction well downgradient of the source area, detected about 100 µg/l of TCE and 200 µg/l of total VOCs in the October 1990 sampling. Groundwater pollution in the deeper aquifers was originally the most concentrated in well T-2B. Currently the highest TCE concentration in onsite wells is in well T-2B an extraction well in aquifer B1, with a concentration of 19,000 µg/l.

Offsite the pollution extends to a depth of up to 100 feet and extends laterally downgradient for approximately 4000 feet. The offsite downgradient plume has commingled with pollutants derived from point sources at AMD, 901/902 Thompson Place, and Signetics 811 Arques facilities. The extent of the lateral migration of groundwater pollution is difficult to assess due to the commingling of the groundwater plumes. The groundwater contamination does not appear to have had an impact on any special ecological environment or endangered populations based upon no current direct use of the groundwater and from measurements of the VOCs coming off the soils.

The remaining soil contamination is minimal and occurs at depths greater than ten feet. The maximum vadose zone contamination is about 4 ppm. With current technology it is not possible to separate the higher levels of soil contamination in the saturated zone soil from the groundwater contamination. However the remaining soil contamination does not present any known impacts that will not be remediated by the groundwater extraction system.

10. Baseline Public Health Evaluation A Baseline Public Health Evaluation (BPHE) is conducted at every Superfund site to evaluate the risk posed by the site in its existing condition. The BPHE examines the chemicals present at the site and the possible routes of exposure to humans and animals. Once the potential risk or hazard from the site is established, judgments can be made as to which environmental laws and standards are applicable to the situation and what cleanup goals are appropriate.

Chemicals of Concern Using very conservative assumptions regarding concentration, distribution, toxicity, and potential routes of exposure, the BPHE (*Clement, 1990*) identified twenty-eight "chemicals of potential concern" for groundwater. This included

sixteen organic chemicals and twelve inorganic chemicals. Further evaluation of the groundwater data in the FS has resulted in the reduction of the number of organic chemicals to ten chemicals of concern and the elimination of all the inorganics. The FS also presents the chemicals of concern by operable unit. The chemicals of concern for the Companies site in the FS are listed in Appendix 2, Table 1.

Exposure Scenarios Using similarly conservative assumptions, the BPHE also developed current and future exposure scenarios. The potential current exposure scenario considered in the BPHE evaluated inhalation of VOC vapors originating from the offsite groundwater plume. For the hypothetical future exposure scenarios, it was assumed that the onsite areas of the site would be developed for residential use and that the groundwater in the A- and B-aquifers would be used for domestic purposes.

According to the BPHE, **potential future exposure** routes at the Companies site may include ingestion of groundwater containing the chemicals of potential concern, inhalation of VOC vapors from groundwater during showering or other domestic uses, and inhalation of VOC vapors originating from the groundwater. Based on the absence of known soil "hot-spots", other than those well below ground surface and beneath buildings, direct contact exposure to chemicals of concern was not fully evaluated.

In addition to the assumptions mentioned above, the BPHE also assumed that the current cleanup actions would be discontinued and cleanup measures would not be implemented at any time in the future. Using these assumptions, the BPHE concluded that the only **average exposure scenario** for which there would be a potential health risk or an increased cancer risk greater than 1 in 10,000 was the hypothetical future domestic use of contaminated shallow groundwater. The most crucial of these assumptions is that cleanup activity in the study area would cease. This implies that current concentrations in groundwater would persist into the future.

The only **current exposure identified** in the BPHE is indoor exposure to vapors migrating from the contaminated groundwater in the offsite area. This pathway was evaluated for two separate populations, residents of the offsite area and children attending the San Miguel school. These cancer risks and health hazard assessments are based on estimates of the indoor air concentrations of the chemicals of concern predicted by mathematical models. The predicted carcinogenic risk for the average case is estimated to be about 4 in 100,000,000 for schoolchildren and about 1 in 10,000 for residents. The model does not predict any toxic effects from this exposure. This is within the risk range that would be allowable under EPA guidance after cleanup.

The **future use scenarios** considered by the BPHE is domestic use of shallow groundwater beneath the site. This would expose residents to contaminated groundwater through ingestion of water and inhalation during domestic use (showering, cooking, etc.). The greatest potential carcinogenic risk related to the average exposure through these pathways is approximately 2 in 1000.

Domestic use is a hypothetical case since shallow groundwater in the A- and B-aquifers is not currently used for water-supply purposes and local ordinances prohibit such practice. Currently, there are no plans to use the A- and B-aquifer groundwater as a drinking water supply. However, it is the intent of the proposed final RAP presented in this Tentative Order to protect the beneficial use of this resource as a potential source of drinking water.

The BPHE assumption that there will be no continued or further cleanup is invalid. Based on the potential risk identified by the BPHE it is appropriate to cleanup the groundwater. The Companies have been cleaning up contaminated groundwater from the site since 1982. It is the intent of this Order and actions taken by the Board and other agencies to provide that these efforts will continue.

11. Chemicals Of Concern The BPHE identified chemicals of concern for the study area based on toxicity and frequency of detection for soil and groundwater data. The presence of these chemicals varies between the OUs and subsets of the chemicals of concern have been developed for each OU (see Appendix 2, Table 1). In addition new data on inorganics has been collected since the completion of the BPHE. This data indicates that inorganics are not present in groundwater above naturally occurring levels. Therefore inorganics are no longer considered to be chemicals of concern. Also the listing of some compounds as chemicals of concern for groundwater in the BPHE is based on the mobility of the chemical and its occurrence in soil samples. The assumption being that if these chemicals occur in soil they will occur in groundwater. In the instances where these chemicals have never been detected in groundwater the FS did not include these chemicals as chemicals of concern.

Chemicals of concern identified in the FS for the TRW OU include 1,1-dichloroethane (1,1-DCA), 1,1-dichloroethylene (1,1-DCE), cis-1,2-dichloroethylene (cis-1,2-DCE), trans-1,2-dichloroethylene (trans-1,2-DCE), TCE, 1,1,1-TCA, PCE, 1,2-dichlorobenzene (DCB), vinyl chloride (VC), and Freon 113. The chemicals of concern identified for the Offsite OU include all of the above except DCB and VC. TCE is the chemical most commonly present and serves as an indicator chemical for the TRW OU and the other OUs within the study area.

All of these chemicals are potentially toxic at some concentration. VC is a known human carcinogen (EPA class A). 1,1-DCA, PCE, and TCE are considered to be potential or probable human carcinogens (EPA class B1 and B2). 1,1-DCE is a possible human carcinogen (EPA class C).

12. Interim Remedial Actions, Onsite Soil Interim actions to deal with soil pollution began in 1983 with the removal of the underground waste solvent storage tank and some associated polluted soil. Additional soil was removed from this same area in 1984. All the polluted soil could not be removed due to the proximity of the foundation of the 825 Stewart building to the excavation. The total soil removed for offsite disposal from the solvent tank area was about 120 cubic yards.

Soil pollution near the waste solvent tank was investigated again in 1988 to determine what levels of soil pollution remain in place near 825 Stewart. The highest levels of soil pollution sampled in the unsaturated zone by this investigation were 4 mg/kg total VOCs. Levels of VOCs found in the saturated zone were as a high as 34 mg/kg.

Investigation in the area of the underground acid neutralization system and its associated piping system was completed in 1985 and 1986. No VOCs were detected in either area, however some areas of possible metals pollution were located.

13. Interim Remedial Actions, Onsite Groundwater Initial actions to deal with groundwater pollution at the 825 Stewart Drive site began in 1984 with the installation of an eductor in the waste solvent tank excavation. Additional extraction wells were created in 1984 by the conversion of some existing monitoring wells.

Groundwater extraction currently involves seven extraction wells, three A zone wells, three B1 aquifer wells, and one B2 extraction well. Due to the depressed water table little water has been extracted from the waste solvent tank excavation by the eductor since 1987 and the remaining A aquifer wells operated cyclically.

The extracted groundwater is treated by an air stripping system at the 825 Stewart site. After treatment the water is released to surface waters under NPDES Permit Number CA0028886.

14. Interim Remedial Actions, Offsite Groundwater Two offsite groundwater containment extraction systems have been installed. The Duane Avenue Extraction system, consisting of nine extraction wells, is located just south of Duane Avenue, approximately 1200 to 2100 feet downgradient (north) of the AMD, Signetics, and TRW operable units. This extraction system was installed and began operation in 1986. The Duane Avenue system extracts water from the A, B1, B2, B3 and B4 aquifers.

A second extraction system consisting of fourteen wells, along Alvarado Avenue, approximately 2700 to 4300 feet downgradient (north) of the AMD, Signetics And TRW operable units, was completed in 1988. Operation of the Alvarado Avenue system began in October 1988. This system extracts water from the A, B1, and B2 aquifers. Data has been collected for the evaluation of both extraction systems and a report evaluating the effectiveness of the systems was submitted on March 10, 1989.

The extracted groundwater is transferred by a piping system to AMD's 915 DeGuigne facility where the water is treated. About 30% of the treated water is utilized as process make-up water by the AMD 915 facility and the remainder is released to surface water under NPDES Permit Number CA0028797.

15. Vertical Conduit Study A well search for abandoned wells in a 3350 acre area encompassing the study area was completed in December 1986. This includes over one mile in all directions and over three miles in the downgradient direction. The focus of the well search was to identify wells that potentially may form migration pathways to the deeper aquifer. The search identified 177 possible well

locations. Of these wells 76 are identified as destroyed. Only two of the wells were within the groundwater contamination plume area. Further investigation indicated that one of these wells was a cathodic protection well maintained by PG&E. This type of well is frequently installed to inhibit rust in underground pipelines. These wells are typically shallow (i.e. pipeline depth) and cased with steel. No additional data was available on the other well and attempts to field check the well location were unsuccessful.

Two municipal supply wells were identified by the potential conduit study. Well ID number 1845 is a City of Sunnyvale water supply well. This well is over 3000 feet upgradient of the known groundwater contamination plume. Well ID number T6SR1WS29N2 T6SR1WS29 is also upgradient of the groundwater pollution plume and is shown in Santa Clara Valley Water District records as destroyed.

16. Data Quality Development of the Board's final RAP was based on four criteria: 1) data was collected following an approved sampling and analysis plan, 2) random sample splits were collected by Board staff to confirm the validity of data generated by TRW, 3) TRW's data was validated by the Department of Health Services and found to be at least qualitatively acceptable, and 4) there has been reasonable repeatability of the data based on seven years of monitoring. Thus the Board finds that there is sufficient acceptable data to make cleanup decisions.

17. Description of Remedial Alternatives Initially, a large number of cleanup methods (technologies) were screened with respect to their effectiveness, implementability, and order-of-magnitude cost. The methods which passed this initial screening were then combined into cleanup alternatives most applicable to each Operable Unit and evaluated in detail. The detailed analysis included an evaluation based on the nine criteria listed below:

- o Overall protection of human health and the environment
- o Compliance with ARARs
- o Short-term effectiveness
- o Long-term effectiveness
- o Reduction of toxicity, mobility, or volume
- o Implementability
- o Cost
- o State acceptance
- o Community acceptance.

The cleanup alternatives which were so evaluated for TRW and the Offsite OU are described below. The results of the nine criteria evaluation are presented in Finding 18.

TRW Operable Unit

Alternatives for remediation of soil have been incorporated into comprehensive groundwater remediation alternatives (see Appendix 2, Table 2).

Alternative 1: No Action Alternative 1 is a no further action alternative. All current remedial activities would be stopped.

Alternative 2: Current Groundwater Extraction System With Alternative 2, groundwater extraction from the 7 well/1 eductor system, groundwater treatment by air stripping, and groundwater discharge under an NPDES permit would continue. No additional remedial technology would be required, although the present system would be upgraded as part of normal maintenance and replacement. This alternative would also include deed restrictions on the use of groundwater in the A– and B–aquifers.

The FS estimates that this alternative would require at least 7 years of operation to reach compliance with applicable, relevant, and appropriate requirements (ARARs) and eleven years to approach non-detect levels of organic chemicals. The estimated present worth cost of this alternative is $800,000.00 to achieve ARARs and $1,100,000.00 to approach background levels.

Alternative 3: Soil Flushing and Groundwater Extraction Alternative 3 combines the components for Alternative 2 with flushing of source area soils. Soil flushing should increase water saturation of, and circulation through, soils, and might increase the potential for VOC desorption from soils to groundwater, thus reducing the time for VOC removal from the subsurface soil.

The FS estimates that this alternative would require at least 7 years of operation to reach compliance with ARARs and eleven years to approach non-detect levels of organic chemicals. The estimated present worth cost of this alternative is $800,000.00 to achieve ARARs and $1,200,000.00 to approach background levels.

Alternative 4: Partial Excavation and Groundwater Extraction Alternative 4 consists of excavating the most highly contaminated soils north and west of the former tank area, dewatering the entire excavated area, and backfilling the excavation with clean material. This alternative would also include deed restrictions on the use of groundwater in the A– and B–aquifers and continued pumping, treatment, and discharge of groundwater from existing and two new extraction wells. This alternative would require significant engineering controls prior to and during excavation, as well as relocation of operational equipment.

The FS estimates that this alternative would require at least 7 years of operation to reach compliance with ARARs and eleven years to approach non-detect levels of organic chemicals. The estimated present worth cost of this alternative is $1,600,000.00 to achieve ARARs and $2,000,000.00 to approach background levels.

Offsite Operable Unit

Remedial alternatives for soil were not addressed for the Offsite Operable Unit because contaminant sources in soil are limited to the onsite operable units. The Alternatives for groundwater are listed in Appendix 2, Table 3.

Alternative 1: No Action The no action alternative involves no further action to treat, contain, or remove any of the contaminated groundwater. To implement this alternative, planned and existing remedial measures would be discontinued. Groundwater monitoring would continue. Time for the groundwater to achieve compliance with

ARARs is unknown, with best estimates in the range of hundreds of years. The present worth cost is projected to be $1,900,000.00.

Alternative 2: Expanded Extraction, Air Stripping, and Carbon Adsorption: This alternative consists of continued operation of the existing Offsite extraction and treatment system. The system currently extracts groundwater from 23 extraction wells. The extracted groundwater is conveyed through an underground piping system to the AMD Building 915 treatment facility; the groundwater is treated by air stripping followed by aqueous carbon adsorption. Currently, about 30 percent of the treated groundwater is reused at the AMD facility, with the remainder discharged under NPDES permit CA0028797 to the storm drain system. The spent carbon is removed and regenerated offsite approximately every 1.5 years.

The hydraulic performance evaluation of the extraction system indicated that because of declining water levels, hydraulic capture is not being fully maintained in the A- and B2-aquifers. It is estimated that 5 new A-aquifer extraction wells (or an extraction trench) and 3 new B2-aquifer wells may be needed to maintain adequate capture. Based on results of a simplified model it is estimated that this alternative could meet groundwater ARARs in 36 years. The present worth cost for this alternative is estimated at $4,400,000.00.

Alternative 3: Extraction and Carbon Adsorption This alternative consists of pumping groundwater from the upgraded offsite extraction systems and treatment of the water by carbon adsorption. The treated groundwater would be reused and/or discharged under NPDES permit CA0028797 permit to the storm drain system. This alternative differs from Alternative 2 in that VOC removal is accomplished by means of a carbon adsorption unit only, rather than by use of a combined air stripping/carbon adsorption system. The estimated time to achieve cleanup is 36 years, the same as Alternative 2. The present worth cost for this alternative is estimated at $10,000,000.00.

18. Evaluation of Remedial Alternatives As previously mentioned, the alternatives for each Operable Unit were evaluated using the nine FS criteria. Tables 2 and 3 in Appendix 2 summarize the results of the evaluation using the first seven criteria; evaluation of community and agency acceptance will be is deferred until after the public comment period.

TRW Operable Unit

Proposed Alternative

Alternative 2 - Current Groundwater Extraction System is the recommended cleanup measure for soil and groundwater cleanup at the TRW Operable Unit. This alternative is protective of human health and the environment, complies with ARARs, is effective in both the long- and short-term, reduces the toxicity, mobility and volume of the contaminants, is currently in operation, and is cost-effective. Trench and piping improvements would enhance the performance of the system. In addition this system has demonstrated its effectiveness in reducing contaminant levels in groundwater and controlling migration of contaminated groundwater. The present

worth cost of this system to achieve ARARs is estimated to be $800,000.00.

Rejected Alternatives

Alternative 1, no action, does not satisfy ARARs and is not protective of human health or the environment and would not satisfy State Board Resolution 68-16. No further consideration was given to alternative 1.

A pilot study of soil flushing (Alternative 3) indicated that, at least for the TRW site, the increased volumes of water extracted did not result in a noticeable increase in the mass removal rate. The reinjection of treated water as part of the soil flushing system might result in increased hydraulic head and potential for vertical migration. Controls and additional monitoring would be required for a soil flushing system to monitor and control the increased hydraulic head. However, since no improvement in cleanup time or reduction of mobility, toxicity or volume would be expected the potential increased mobility of contaminants is not warranted and this alternative was rejected.

Alternative 4, soil excavation and groundwater extraction, was not selected because of the difficulty in implementing the excavation. The soil removal would be in an area currently containing process equipment. The excavation would require relocating this equipment or a temporary shutdown of operations at the facility. In addition, the volume of contaminated soil remaining in the vadose zone is small and the contaminated soil in the shallow saturated zone would be recontaminated by migration of contaminated groundwater from offsite.

Offsite Operable Unit

Proposed Alternative

Extraction, Air Stripping, and Carbon Adsorption is the recommended cleanup measure for the Offsite Operable Unit. This alternative provides good protection of human health and the environment, complies with ARARs, is effective in both the long- and short-term, reduces the toxicity, mobility, and volume of VOCs, is currently in operation, and is cost-effective. Upgrading the current extraction/treatment system with additional wells and/or trenches would improve the performance of the system. The current system's performance is in part due to low water levels in the A zone resulting from the drought and groundwater extraction. The actual number, depth, and location of additional extraction wells that will be required to improve system performance will be determined as part of the remedial assessment remedial design (RA/RD) process (see Provision C.4.i., Task 10). Based on results of a simplified model it is estimated that this alternative could meet groundwater ARARs in 36 years. The present worth cost for this alternative is estimated at $4,400,000.00.

Rejected Alternatives

The other alternatives considered for the Offsite OU were the no action, Alternative 1, which would not be protective of human health or the environment, and Alterative 3, groundwater extraction with treatment by carbon adsorption. The no action alternative is included only for comparison and no further consideration will be given to this alternative. The only advantage that treatment by carbon adsorption alone as compared to treatment by an air stripper followed by carbon adsorption is the elimination of the release of offgas and the potential for increased permanent destruction of contaminants after removal. The present worth cost for carbon adsorption treatment alone is estimated at $10,000,000.00, more than twice the estimated cost of air stripping followed by carbon adsorption.

In summary the proposed final cleanup plan would include the following components:

1. Continued groundwater and soil flux monitoring,

2. Continued groundwater extraction and treatment with the existing system at TRW,

3. Modification of the Alvarado and Duane Avenue offsite extraction systems and continued groundwater extraction from these modified systems for the Offsite OU. The modification would focus on improving control of the A zone pollutant plume under the current drought conditions. Treatment would continue with the existing system at AMD 915 with air stripping followed by aqueous phase carbon treatment. The carbon is transfered to a licensed facility where it is regenerated by the use of a rotary kiln and reused at the AMD facility. The treated water is either discharged under NPDES permit or reused onsite, and

4. Implementation of institutional constraints for the TRW OU until cleanup standards are achieved.

19. Cleanup Standards The cleanup standards must meet all applicable, relevant and appropriate requirements (ARARs) and be protective of human health and the environment. There are no ARARs for soil cleanup. However, the chemicals of concern in soil are the same as those in groundwater, predominantly VOCs. The presence of VOCs at high concentrations would present a continued threat to water quality. The Board has proposed a cleanup standard of 1 part per million (ppm) total VOCs for vadose zone soil. As an alternative to this cleanup level the discharger was provided the option of providing a technical demonstration that levels of VOCs greater than 1 ppm could remain in place in the soil without partitioning from soil into groundwater at levels above groundwater cleanup standards. The latter has not been demonstrated for this site.

Cleanup standards for groundwater are shown, as shaded, in Appendix 2, Table 4 of this Order. The standards for nine of the ten chemicals of concern for the TRW and Offsite operable units are the California maximum contaminant levels (MCLs) for drinking water. The exception is 1,2-dichlorobenzene, for which California has not established an MCL. The cleanup standard for 1,2-dichlorobenzene

shall be the proposed Federal MCL. Since groundwater cleanup levels are based on MCLs this will meet all ARARs for groundwater cleanup.

An additional concern that is discussed in the FS is the potential contamination of the air at the TRW OU and the AMD 915 site. The appropriate standards for this consideration are the regulations of the Bay Area Air Quality Management District (BAAQMD) Regulation 8, Rule 47 which is an ARAR for this facility. The air stripper systems at TRW and AMD 915 DeGuigne Drive sites are regulated by the BAAQMD. The air stripper offgas from the system at TRW is not controlled or treated. The air stripper offgas at AMD 915 (offsite extraction system treatment) is not treated. Air emissions from the AMD 915 facility as a whole, including the air stripper, were required to be evaluated by the BAAQMD under AB 2588. This evaluation ranked the AMD 915 complex as a medium priority. Based on this ranking a health risk assessment for air emissions was not required by the BAAQMD. The air emissions from these units do satisfy the ARAR cited above as regulated by the BAAQMD.

20. Risk Associated With Cleanup Standards The selected remedy is protective of human health and the environment -- as required by Section 121 of CERCLA -- in that pollution in groundwater is treated to at least MCLs and falls within EPA's acceptable carcinogenic risk range and noncarcinogenic hazard index. EPA's acceptable carcinogenic risk range for cleanup standards selected for a site is 10^{-4} to 10^{-6} as an acceptable cleanup level. If the noncarcinogenic hazard index is less than one, EPA considers the combined intake of chemicals unlikely to pose a health risk.

At the TRW OU The carcinogenic risk at the cleanup standards (for all chemical listed in Appendix 2, Table 4) associated with the potential future use scenario of groundwater ingestion and inhalation of VOCs from groundwater during domestic use is 4×10^{-5}. In cleaning up TCE, the predominant chemical of concern, to the 5 ppb cleanup standard it is quite likely that the concentrations of other VOCs will be reduced to levels below the 5 ppb range. This risk represents the maximum residual risk that would be probable following cleanup. This estimated risk is based on cleanup to MCLs for all carcinogenic chemicals of concern identified in the FS for the TRW OU and assumes that all of these chemicals would be present in groundwater extracted for domestic use. It is probable that this is an overestimate of the actual residual risk after cleanup.

This excess cancer risk estimate for the TRW OU includes 1,1-DCE which is classified by the EPA as a possible human carcinogen (Class C). This classification is currently under review and the California Department of Health Services (DOHS) does not recommend including 1,1-DCE in risk calculations as a carcinogen. If 1,1-DCE is not included in the carcinogen the estimated residual risk after cleanup associated with the potential future use scenario of groundwater through ingestion and inhalation of VOCs from groundwater in the TRW OU is 6×10^{-6}.

For the Offsite OU The carcinogenic risk for the four chemicals of concern identified as carcinogens for the (1,1-DCA, 1,1-DCE, PCE, and TCE) associated with the potential future use scenario of groundwater ingestion and inhalation of VOCs from groundwater from the Offsite OU is 4×10^{-5}. This estimate is based on the exposure

that would be experienced if all four chemicals were present at the concentration required by the cleanup standards. In addition this risk includes 1,1-DCE which is classified by the EPA as a possible human carcinogen. This classification is currently under review and the California Department of Health Services (DOHS) does not recommend including 1,1-DCE in risk calculations as a carcinogen. If 1,1-DCE is not included in the carcinogen the estimated residual risk after cleanup associated with the potential future use scenario of groundwater through ingestion and inhalation of VOCs from groundwater in the Offsite OU is 3×10^{-6}.

The noncarcinogenic hazard index associated with the cleanup standards at the TRW OU is 0.10. The noncarcinogenic hazard index associated with the cleanup standards at the Offsite OU is 0.20. The low hazard index at these OUs is a function of the small number of chemicals of concern identified for the Offsite OU.

The method and assumptions used to obtain the carcinogenic risk and the hazard index associated with the cleanup standards are contained in the BPHE and FS. A number of assumptions have been made in the derivation of these values, many of which are intentional overestimates of exposure and/or toxicity. The actual incidence of cancer is likely to be lower than these estimates and may even be zero. The cleanup standards for the site are protective of human health, have a carcinogenic risk that falls within a range of 10^{-6} to 10^{-4}, and a hazard index of less than one. No environmentally sensitive populations or habitats have been identified within the study area.

21. Uncertainty in Achieving Cleanup Standards The goal of this remedial action is to restore groundwater to its beneficial uses. Based on information obtained during the RI and on a careful analysis of all remedial alternatives, the Board believes that the selected remedy will achieve this goal. However, studies suggest that groundwater extraction and treatment will not be, in all cases, completely successful in reducing contaminants to health-based levels in the aquifer zones. The Board recognizes that operation of the selected extraction and treatment system may demonstrate the technical impracticability of reaching health-based groundwater quality standards using this approach. If it becomes apparent, during implementation or operation of the system, that contaminant levels have ceased to decline and are remaining constant at levels higher than the remediation standards, those standards and the remedy may be reevaluated.

The selected remedy will include groundwater extraction for a period of up to 7 years at the TRW OU and up to 36 years in the offsite area, during which the system's performance will be carefully monitored on a regular basis and adjusted as warranted by the performance data collected during operation. Modifications may include:

a) discontinuing operation of extraction wells in areas where cleanup standards have been attained;

b) alternating pumping at wells to eliminate stagnation points; and

c) pulse pumping to allow aquifer equilibration and encourage adsorbed contaminants to partition into groundwater.

The projected times to achieve cleanup included in this Order are developed in the FS. These times are derived from a simple groundwater model and are intended to provide a basis of comparison for the screening of alternatives. It is probable that these models provide an underestimate of the time required to achieve the cleanup standards specified in this Order.

22. Future Changes to Cleanup Levels If new information indicates cleanup standards cannot be attained or can reasonably be surpassed, the Regional Board will decide if further final cleanup actions beyond those completed shall be implemented at this site. If changes to the cleanup standards or amended cleanup standards are proposed, due to the claimed technical infeasibility of attaining the standards, adopted by this Order, a new Order will be submitted to the Board for consideration and to EPA Region IX for their concurrence. If changes in health criteria, administrative requirements, site conditions, or remediation efficiency occur, the discharger will submit an evaluation of the effects of these changes on cleanup levels as specified under Provisions C.4.h. and C.4.p.

The Regional Board will not require the discharger to undertake additional remedial actions with respect to the matters previously described herein unless: (1) conditions on the site, previously unknown to the Regional Board, are discovered after adoption of this Order, or (2) new information is received by the Regional Board, in whole or in part after the date of this Order, and these previously unknown conditions or this new information indicates that the remedial actions required in this Order may not be protective of public health and the environment. The Regional Board will also consider technical practicality, cost effectiveness, State Board Resolution No. 68-16 and other factors evaluated by the Regional Board in issuing this Order in determining whether such additional remedial actions are appropriate and necessary.

23. Community Involvement An aggressive Community Relations program has been ongoing for all Santa Clara Valley Superfund sites, including TRW. The Board published a notice in the San Jose Mercury News on March 13,20, and 27, 1991, announcing the proposed final cleanup plan and opportunity for public comment at the Board Hearing of March 20, 1991 in Oakland, and announcing the opportunity for public comment at an evening public meeting held at the Westinghouse Auditorium, Britton at East Duane Avenue, in the City of Sunnyvale on Thursday March 28, 1991. Public comment was received during an extended 60 day period (at community request) from March 20 through May 20, 1991.

Fact Sheets were mailed to interested residents, local government officials, and media representatives. Fact Sheet 1, mailed in december 1989, summarized the pollution problem, the results of investigations to date, and the interim remedial actions. Fact Sheet 2, mailed in March 1991, described the cleanup alternatives evaluated, explained the proposed final RAP, announced opportunities for public comment at the Board Hearing of March 20,

1991 in Oakland and the Public Meeting of March 28, 1991 in Sunnyvale and described the availability of further information at the Information Repository at the City of Sunnyvale Library and the Regional Board offices. Written comments received from the community meeting of March 28, 1991, and at an informal meeting held on May 7, 1991 are reviewed in the Responsiveness Summary included as Appendix 3.

24. State Board Resolution No. 68-16, "Statement of Policy with Respect to Maintaining High Quality Waters in California" On October 28, 1968, the State Water Resources Control Board adopted Resolution No. 68-16, "Statement of Policy with Respect to Maintaining High Quality Waters in California". This policy calls for maintaining the existing high quality of State waters unless it is demonstrated that any change would be consistent with the maximum public benefit and not unreasonably affect beneficial uses. The original discharge of waste to the groundwater at these sites was in violation of this policy; therefore, the groundwater quality needs to be restored to its original quality to the extent reasonable. For the purpose of establishing cleanup objectives, the shallow groundwater at the site is designated a potential source of drinking water (see finding 7).

The FS evaluated groundwater cleanup to background or non-detect levels. Cleanup to non-detect levels would increase estimated groundwater cleanup times by between 33% and 50% and add significantly to cost. In addition, cleanup of groundwater to below the MCL for the chemicals of concern may not be achievable due to the technical difficulties in restoring aquifers by the removal of low concentrations of any VOC. This is due to the slow, non-linear desorption of VOCs adsorbed to the inner pore spaces of soil particles which make up the aquifer material and VOCs adsorbed to clays and organic matter in the aquitard. Cleanup to MCL levels would protect the primary beneficial use of the groundwater as a potential source of drinking water. For these reasons, MCLs were accepted as concentrations that meet the intent of Resolution No. 68-16.

The proposed remedial water quality standards meet current applicable health criteria and restore the quality of the groundwater to the extent reasonable given technical and economic constraints. These constraints include the high additional incremental costs for removal of small amounts of additional chemicals and the need to minimize the removal of groundwater to achieve acceptable remedial standards.

25. Groundwater Conservation TRW has considered the feasibility of reclamation, reuse, or discharge to a publicly owned treatment works (POTW) of extracted groundwater from 825 Stewart Drive, as specified in Board Resolution No. 88-160. Since TRW, the responsible party, does not operate the facility industrial reuse of the groundwater after treatment is difficult. Use as irrigation water in the area is limited by small areas of landscaping and the availability of reclaimed water from the nearby Sunnyvale POTW. The POTW will not accept treated groundwater in the sanitary treatment system. Therefore discharge to the storm sewer under NPDES Permit Number CA0028886. The discharger will be required to re-evaluate reuse potential on a yearly basis.

The extracted groundwater from the offsite system is piped to AMD 915 for treatment. Reuse at the AMD 915 facility, which includes water from an onsite remedial groundwater extraction system, currently is at about 30% of the total volume. It is anticipated that this will reach 80% during 1991 with a goal of 100% reuse.

26. Basin Plan The Board adopted a revised Water Quality Control Plan for the San Francisco Bay Basin (Basin Plan) on December 17, 1986. The Basin Plan contains water quality objectives and beneficial uses for South San Francisco Bay and contiguous surface and ground waters.

27. Beneficial Use The existing and potential beneficial uses of the groundwater underlying and adjacent to the facility include:

    a. Industrial process water supply
    b. Industrial service water supply
    c. Municipal and Domestic water supply
    d. Agricultural water supply

28. The discharger has caused or permitted, and threatens to cause or permit waste to be discharged or deposited where it is or probably will be discharged to waters of the State and creates or threatens to create a condition of pollution or nuisance.

29. This action is an order to enforce the laws and regulations administered by the Board. This action is categorically exempt from the provisions of the CEQA pursuant to Section 15321 of the Resources Agency Guidelines.

30. Onsite and offsite interim containment and cleanup measures need to be continued to alleviate the threat to the environment posed by the continued migration of pollutants and to provide a substantive technical basis for designing and evaluating the effectiveness of final cleanup alternatives.

31. The Board has notified the discharger and interested agencies and persons of its intent under California Water Code Section 13304 to prescribe Site Cleanup Requirements for the discharge and has provided them with the opportunity for a public hearing and an opportunity to submit their written views and recommendations.

32. The Board, in a public meeting on June 19, 1991, heard and considered all comments pertaining to the discharge.

IT IS HEREBY ORDERED, pursuant to Section 13304 of the California Water Code, that the dischargers its agents and successors or assigns shall cleanup and abate the effects described in the above findings as follows:

A. **PROHIBITIONS**

1. The discharge of wastes or hazardous materials in a manner which will degrade water quality or adversely affect the beneficial uses of the waters of the State is prohibited.

2. Further significant migration of pollutants through subsurface transport to waters of the State is prohibited.

3. Activities associated with the subsurface investigation and cleanup which will cause significant adverse migration of pollutants are prohibited.

B. **SPECIFICATIONS**

1. The storage, handling, treatment or disposal of soil or groundwater containing pollutants shall not create a nuisance as defined in Section 13050(m) of the California Water Code.

2. The discharger shall conduct monitoring activities as outlined in the revised sampling plan dated October 27, 1987, or as revised later, to define the current local hydrogeologic conditions, and the lateral and vertical extent of soil and groundwater pollution. Should monitoring results show evidence of pollutant migration, additional characterization of pollutant extent may be required. Within sixty (60) days of the Executive Officer's determination and actual notice to Tech Facility 1, Inc. and FEI Microwave, Inc. that TRW, Inc. has failed to comply with this paragraph, Tech Facility 1, Inc., and FEI Microwave, Inc., as landowner and operator, shall comply with this specification.

3. Pursuant to Water Code Section 13304(c), the dischargers are hereby notified that the Board is entitled to and may seek reimbursement for all reasonable staff oversight costs incurred relating to cleanup of waste on this site, abating the effects thereof, or taking other remedial action.

C. **PROVISIONS**

1. The discharger shall submit to the Board acceptable monitoring program reports containing results of work performed according to a program as described in the October 1987 field sample and analysis plan, or as amended, and approved by the Executive Officer.

2. All wells in the TRW and Offsite operable units shall be used to determine if cleanup standards have been met.

3. Final cleanup standards for all onsite and offsite wells shall be not greater than the levels as provided in Finding 19 and as shown in Appendix 2, Table 4.

4. The discharger shall comply with Prohibitions and Specifications above, in accordance with the following time schedule and tasks:

TASK/COMPLETION DATE

TRW OPERABLE UNIT

a. TASK 1: PROPOSED CONSTRAINTS: Submit a technical report acceptable to the Executive Officer documenting procedures to be implemented by the dischargers, including a deed restriction prohibiting the use of the

upper aquifer groundwater as a source of drinking water, and for controlling onsite activities that could endanger the public health or the environment due to exposure to VOCs. Constraints shall remain in effect until groundwater cleanup standards have been achieved and pollutant levels have stabilized in onsite aquifers.

COMPLETION DATE: July 28, 1991

b. TASK 2: CONSTRAINTS IMPLEMENTED. Submit a technical report acceptable to the Executive Officer documenting that the proposed and approved constraints have been implemented.

COMPLETION DATE: 60 days after Executive Officer staff approval of Task 1.

c. ADMINISTRATIVE RECORD UPDATE

1) TASK 3: PROPOSED UPDATE. Submit a technical report acceptable to the Executive Officer containing an updated index for the Administrative Record for the period November 1, 1990 through September 30, 1991.

COMPLETION DATE: October 15, 1991

2) TASK 4: UPDATE ADMINISTRATIVE RECORD. Submit a technical report acceptable to the Executive Officer containing the updated Administrative Record documents for the period November 1, 1990 through September 30, 1991.

COMPLETION DATE: December 1, 1991

d. TASK 5: GROUNDWATER REUSE: Submit a technical report "Annual Report - Disposal of Extracted Groundwater" acceptable to the Executive Officer. This report shall be submitted concurrently with the annual groundwater monitoring summary report; and shall address the concerns expressed by this Regional Board Resolution 88-160, Regional Board Position on Disposal of Extracted Groundwater From Groundwater Cleanup Projects and provide an update of the dischargers efforts to reuse or reclaim all or part of the extracted groundwater. This report will be required until 100% reuse is achieved or groundwater extraction is halted.

COMPLETION DATE: March 31, 1992 and yearly thereafter

e. TASK 6: ONSITE WELL PUMPING CURTAILMENT CRITERIA AND PROPOSAL:Submit a technical report acceptable to the Executive Officer containing a proposal for curtailing pumping from onsite groundwater extraction well(s) and trench(s) and the criteria used to justify such curtailment. This report shall include data to show that cleanup standards for all VOCs have been achieved and

have stabilized or are stabilizing, and that the potential for pollutant levels rising above cleanup standards is minimal. This report shall also include an evaluation of the potential for pollutants to migrate downwards to the C aquifer at this location. If the discharger claims that it is not technically feasible to achieve cleanup standards, the report shall evaluate the alternate standards that can be achieved. Cessation of pumping will require the concurrence of the Regional Board and EPA, should either party not concur, continued pumping will be required.

COMPLETION DATE: 90 days prior to proposed implementation of onsite groundwater extraction curtailment

f. TASK 7: IMPLEMENTATION OF ONSITE CURTAILMENT: Submit a technical report acceptable to the Executive Officer documenting completion of the necessary tasks identified in the technical report submitted for Task 6.

COMPLETION DATE; 30 days after the Regional Board approves onsite curtailment

g. TASK 8: FIVE-YEAR STATUS REPORT AND EFFECTIVENESS EVALUATION: Submit a technical report acceptable to the Executive Officer containing the results of any additional investigation including the soil remediation study; an evaluation of the effectiveness of installed final cleanup measures and cleanup costs; additional recommended measures to achieve final cleanup objectives and standards, if necessary; a comparison of previous expected costs with the costs incurred and projected costs necessary to achieve cleanup objectives and standards; and the tasks and time schedule necessary to implement any additional final cleanup measures.

This report shall also describe the reuse of extracted groundwater, evaluate and document the cleanup of polluted groundwater, and evaluate and document the removal and/or cleanup of polluted soil. If safe drinking water levels, through the removal of the chemicals for which this Order specifies cleanup standards, have not been achieved onsite and are not expected to be achieved through continued groundwater extraction and/or soil remediation, this report shall also contain an evaluation addressing whether it is technically feasible to achieve drinking-water quality onsite, and if so, a proposal for procedures to do so.

COMPLETION DATE: June 19, 1996

h. TASK 9: EVALUATION OF NEW HEALTH CRITERIA: Submit a technical report acceptable to the Executive Officer which contains an evaluation of how the final plan and cleanup standards would be affected, if the concentrations as listed in Appendix 2, Table 4 change as a result of changes in source-document conclusions or

promulgation of drinking water standards, maximum contaminant levels or action levels.

COMPLETION DATE: 60 days after request made by the Executive Officer

OFFSITE OPERABLE UNIT

i. TASK 10: SOIL FLUX MONITORING WORKPLAN: Submit a technical report acceptable to the Executive Officer proposing sample locations and a sample schedule for long-term soil flux monitoring of chemicals of concern in the offsite area. The plan shall include sampling and analysis by EPA approved methodology. The schedule shall include seasonal (wet season/dry season) monitoring at locations as proposed and approved, with sampling to commence no later than September 15, 1991.

COMPLETION DATE: August 15, 1991

j. TASK 11: SOIL FLUX MONITORING: Submit a technical report acceptable to the Executive Officer including the results of the monitoring as proposed under Task 10, above. The report shall include results of analysis by EPA approved methodology, appropriately scaled maps, and evaluation of the results of the monitoring including comprehensive tabulations of all data collected and an episodic comparative evaluation of the health risk to residents of the offsite area. This report shall be submitted within forty-five (45) days of the completion of each scheduled sampling event as proposed and approved under Task 10. Following the fourth sample event from commencement of sampling (two years hence), the discharger may propose modification to the number of samples collected, sampling frequency or termination of the sampling program.

COMPLETION DATE: October 30, 1991 and every six months thereafter

k. TASK 12: MODIFICATION TO OFFSITE GROUNDWATER EXTRACTION SYSTEM: Submit a technical report acceptable to the Executive Officer proposing modifications to the offsite groundwater extraction system. This report shall include an evaluation of additional groundwater extraction, especially in the A zone to control migration of pollutants in the A zone. This evaluation may include locations and numbers of additional extraction wells or trenches and mechanical modifications to existing wells to improve system efficiency. Any proposed changes shall include an evaluation of increased groundwater extraction on the treatment system, water reuse, and water conservation. This report shall also include number and proposed location of any additional monitor wells required to improve system monitoring, especially to monitor migration north of the Bayshore Freeway.

COMPLETION DATE: September 15, 1991

l. TASK 13: IMPLEMENTATION OF MODIFICATION TO OFFSITE GROUNDWATER EXTRACTION SYSTEM: Submit a technical report acceptable to the Executive Officer documenting the completion of modifications to the offsite groundwater extraction system. This report shall include well logs and locations for any new wells installed, specifications for modifications to pumps or pump placements, appropriately scaled location maps, and engineering drawings of systems modified as approved under Task 12 above.

COMPLETION DATE: September 15, 1992

m. TASK 14: OFFSITE WELL PUMPING CURTAILMENT CRITERIA AND PROPOSAL: Submit a technical report acceptable to the Executive Officer containing a proposal for curtailing pumping from offsite groundwater extraction well(s) and trench(s) and the criteria used to justify such curtailment. This report shall include data to show that cleanup standards for all VOCs have been achieved and have stabilized or are stabilizing, and that the potential for pollutant levels rising above cleanup standards is minimal. This report shall also include an evaluation of the potential for pollutants to migrate downwards to the C aquifer at this location. If the discharger claims that it is not technically feasible to achieve cleanup standards, the report shall evaluate the alternate standards that can be achieved. Cessation of pumping will require the concurrence of the Regional Board and EPA, should either party not concur, continued pumping will be required.

COMPLETION DATE: 90 days prior to proposed implementation of onsite groundwater extraction curtailment

n. TASK 15: IMPLEMENTATION OF OFFSITE CURTAILMENT: Submit a technical report acceptable to the Executive Officer documenting completion of the necessary tasks identified in the technical report submitted for Task 14. Cessation of pumping will require the concurrence of the Regional Board and EPA, should either party not concur, continued pumping will be required.

COMPLETION DATE; 30 days after the Regional Board approves onsite curtailment

o. TASK 16: FIVE-YEAR STATUS REPORT AND EFFECTIVENESS EVALUATION: Submit a technical report acceptable to the Executive Officer containing the results of any additional investigation including the soil remediation study; an evaluation of the effectiveness of installed final cleanup measures and cleanup costs; additional recommended measures to achieve final cleanup objectives and standards, if necessary; a comparison of previous expected costs with the costs incurred and projected costs necessary to achieve cleanup objectives and standards; and the tasks and time schedule necessary to

implement any additional final cleanup measures.

This report shall also describe the reuse of extracted groundwater, evaluate and document the cleanup of polluted groundwater, and evaluate and document the removal and/or cleanup of polluted soil. If safe drinking water levels, through the removal of the chemicals for which this Order specifies cleanup standards, have not been achieved onsite and are not expected to be achieved through continued groundwater extraction and/or soil remediation, this report shall also contain an evaluation addressing whether it is technically feasible to achieve drinking-water quality onsite, and if so, a proposal for procedures to do so.

COMPLETION DATE: June 19, 1996

p. TASK 17: EVALUATION OF NEW HEALTH CRITERIA: Submit a technical report acceptable to the Executive Officer which contains an evaluation of how the final plan and cleanup standards for the Offsite OU would be affected, if the concentrations as listed in Appendix 2, Table 4 change as a result of changes in source-document conclusions or promulgation of drinking water standards, maximum contaminant level goals, maximum contaminant levels or action levels.

COMPLETION DATE: 60 days after request made by the Executive Officer

3. All Technical reports submitted must be acceptable to the Executive Officer. The submittal of technical reports evaluating interim and final remedial measures shall include a projection of the cost, effectiveness, benefits, and impact on public health and the environment.

4. The remedial investigation and feasibility study shall consider the guidance provided by Subpart F of the National Oil and Hazardous Substances Pollution Contingency Plan (40 CFR Part 300); Section 25356.1 (c) of the California Health and Safety Code; CERCLA guidance documents with reference to Remedial Investigation, Feasibility Studies, and Removal Actions; and the State Water Resources Control Board's Resolution No. 68-16, "Statement of Policy with Respect to Maintaining High Quality of Waters in California".

5. If the discharger is delayed, interrupted or prevented from meeting one or more of the completion dates specified in this Order, the discharger shall notify the Executive Officer prior to the deadline for the completion date.

6. Technical reports summarizing status of compliance with the Prohibitions, Specifications, and Provisions of this Order and progress on completion tasks as identified in the workplan as revised, shall be submitted on a quarterly basis, according to the schedule below, commencing with the report for the third quarter 1991, due October 31, 1991.

Quarter	1st quarter	2nd Quarter	3rd Quarter	4th Quarter
Period	Jan-March	April-June	July-Sept	Oct-Dec
Due Date	April 30	July 31	October 31	January 31

The quarterly reports shall include;

a. a summary of work completed since the previous quarterly report,
b. appropriately scaled and labeled maps showing the location of all monitoring wells, extraction wells, and existing structures,
c. updated water table and piezometric surface maps for all affected water bearing zones, and isoconcentration maps for key pollutants in all affected water bearing zones, shall be included at a minimum in the reports for the second and fourth quarters, or in the event of significant changes,
d. a summary tabulation of all well construction data, groundwater levels and chemical analysis results for site monitor wells specified in the sampling plan,
e. a summary tabulation of volume of extracted groundwater and chemical analysis for all site groundwater extraction wells,
f. an estimate of volume or mass of contaminants removed by each remedial system in the quarter and a cumulative tabulation of the total volume or mass of contaminants removed, (total and #/day)
g. identification of potential problems which will cause or threaten to cause noncompliance with this Order and what actions are being taken or planned to prevent these obstacles from resulting in noncompliance with this Order, and
h. in the event of noncompliance with the Provisions and Specifications of this Order, the report shall include written justification for noncompliance and proposed actions to achieve compliance.

7. All hydrogeological plans, specifications, reports, and documents shall be signed by or stamped with the seal of a registered geologist, engineering geologist or professional engineer.

8. All samples shall be analyzed by State certified laboratories or laboratories accepted by the Board using approved EPA methods for the type of analysis to be performed. All laboratories shall maintain Quality Assurance/Quality Control records for Board review.

9. The discharger shall maintain in good working order, and operate, as efficiently as possible, any facility or control system installed to achieve compliance with the requirements of this Order.

10. Copies of all correspondence, reports, and documents pertaining to compliance with the Prohibitions, Specifications, and Provisions of this Order, shall be provided to the following agencies:

a. Santa Clara Valley Water District
b. Santa Clara County Health Department
c. City of Sunnyvale
d. State Department of Health Services/TSCD
e. U. S. EPA Region IX H-6-3

The Executive Officer may additionally require copies of correspondence, reports and documents pertaining to compliance with the Prohibitions, Specifications, and Provisions of this Order to be provided to a local repository for public use.

11. The discharger shall permit the Board or its authorized representative, in accordance with Section 13267(c) of the California Water Code:

    a. Entry upon premises in which any pollution sources exist, or may potentially exist, or in which any required records are kept, which are relevant to this Order.

    b. Access to copy any records required to be kept under the terms and conditions of this Order.

    c. Inspection of any monitoring equipment or methodology implemented in response to this Order.

    d. Sampling of any groundwater or soil which is accessible, or may become accessible, as part of any investigation or remedial action program undertaken by the discharger.

12. The discharger shall file a report on any changes in site occupancy and ownership associated with the facility described in this Order.

13. If any hazardous substance is discharged to any waters of the state, or discharged and deposited where it is, or probably will be discharged to any waters of the state, the discharger shall report such discharge to this Regional Board, at (415) 464-1255 on weekdays during office hours from 8 a.m. to 5 p.m., and to the Office of Emergency Services at (800) 852-7550 during non-business hours. A written report shall be filed with the Regional Board within five (5) working days and shall contain information relative to: the nature of waste or pollutant, quantity involved, duration of incident, cause of spill, Spill Prevention, Control, and Countermeasure Plan (SPCC) in effect, if any, estimated size of affected area, nature of effect, corrective measures that have been taken or planned, and a schedule of these activities, and persons/-agencies notified.

14. The Board will review this Order periodically and may revise the requirements when necessary.

I, Steven R. Ritchie Executive Officer, do hereby certify that the foregoing is a full, true and correct copy of an Order adopted by the California Regional Water Quality Control Board, San Francisco Bay Region, on June 19, 1991.

Steven R. Ritchie
Executive Officer

Attachments: Appendix 1: Figures 1 - 4
Appendix 2: Tables 1 - 4

APPENDIX 1

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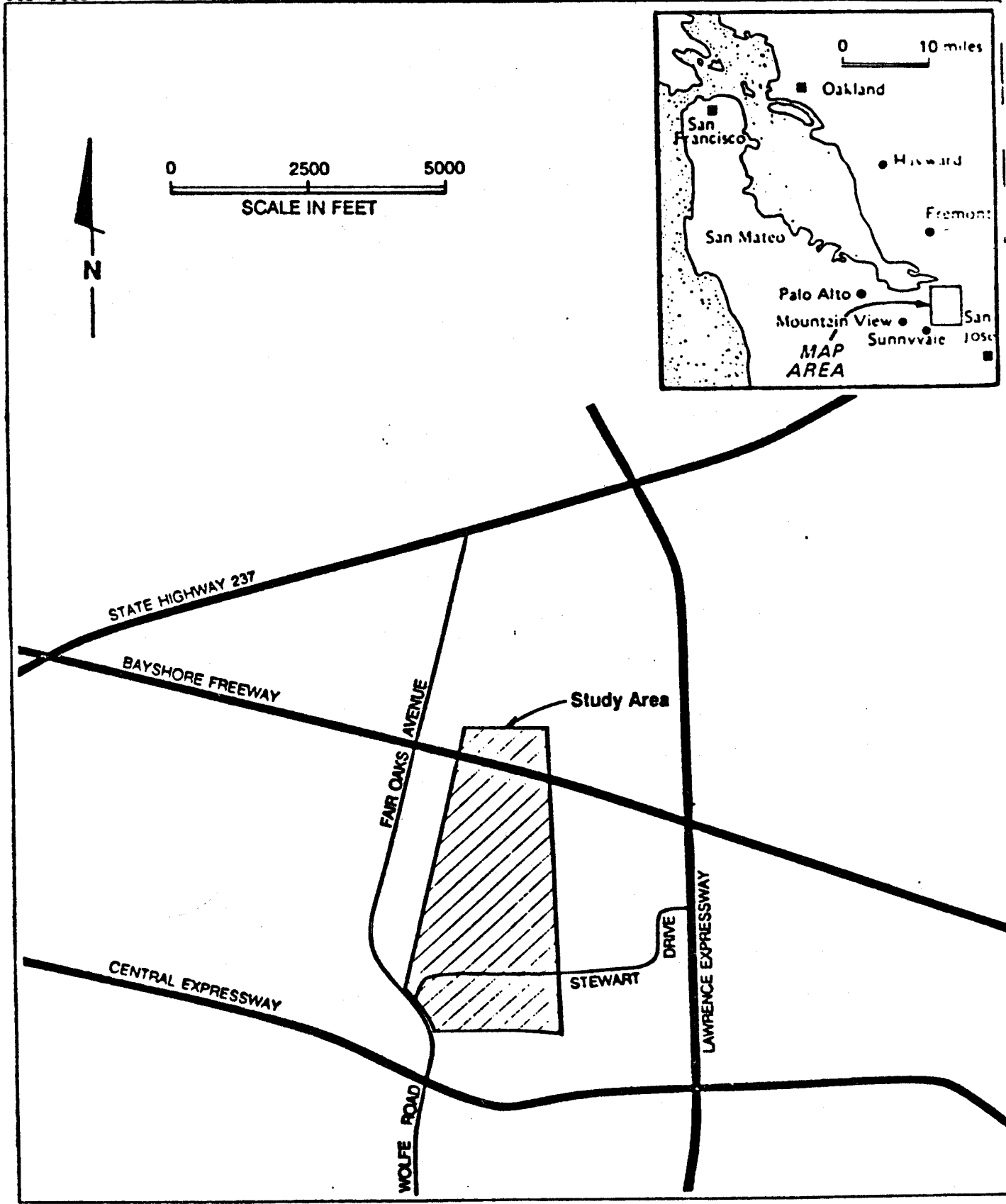
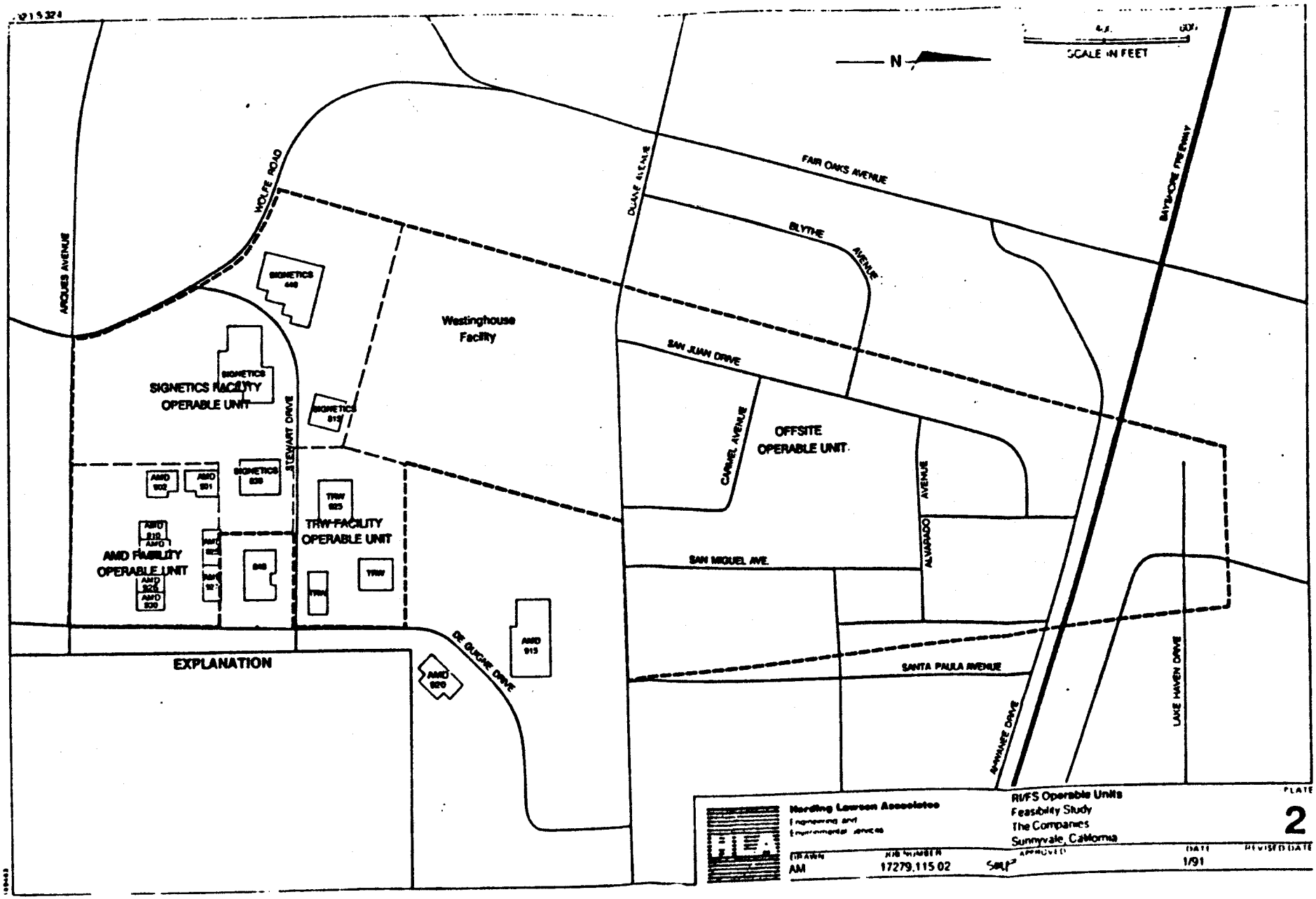


Harding Lawson Associates
Engineers and Geoscientists

Location Map
Feasibility Study
The Companies
Sunnyvale, California

PLATE **1**

DRAWN	JOB NUMBER	APPROVED	DATE	REVISED	DATE
AM	17279,115.02	PAF	1/91		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SCALE IN FEET
WOLFE ROAD
ARQUES AVENUE
DUANE AVENUE
FAIR OAKS AVENUE
BAYSHORE FREEWAY
BLYTHE AVENUE
SAN JUAN DRIVE
CARMEL AVENUE
ALVARADO AVENUE
SAN MIGUEL AVE.
SANTA PAULA AVENUE
ARANJUEZ DRIVE
LAKE HAVEN DRIVE
DE GUIGNE DRIVE
STEWART DRIVE
Westinghouse Facility
SIGNETICS FACILITY OPERABLE UNIT
TRW FACILITY OPERABLE UNIT
AMD FAMILITY OPERABLE UNIT
OFFSITE OPERABLE UNIT
EXPLANATION
Harding Lawson Associates
RI/FS Operable Units
Feasibility Study
The Companies
Sunnyvale, California
PLATE
2
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17279.115.02
APPROVED
DATE
1/91
REVISED DATE

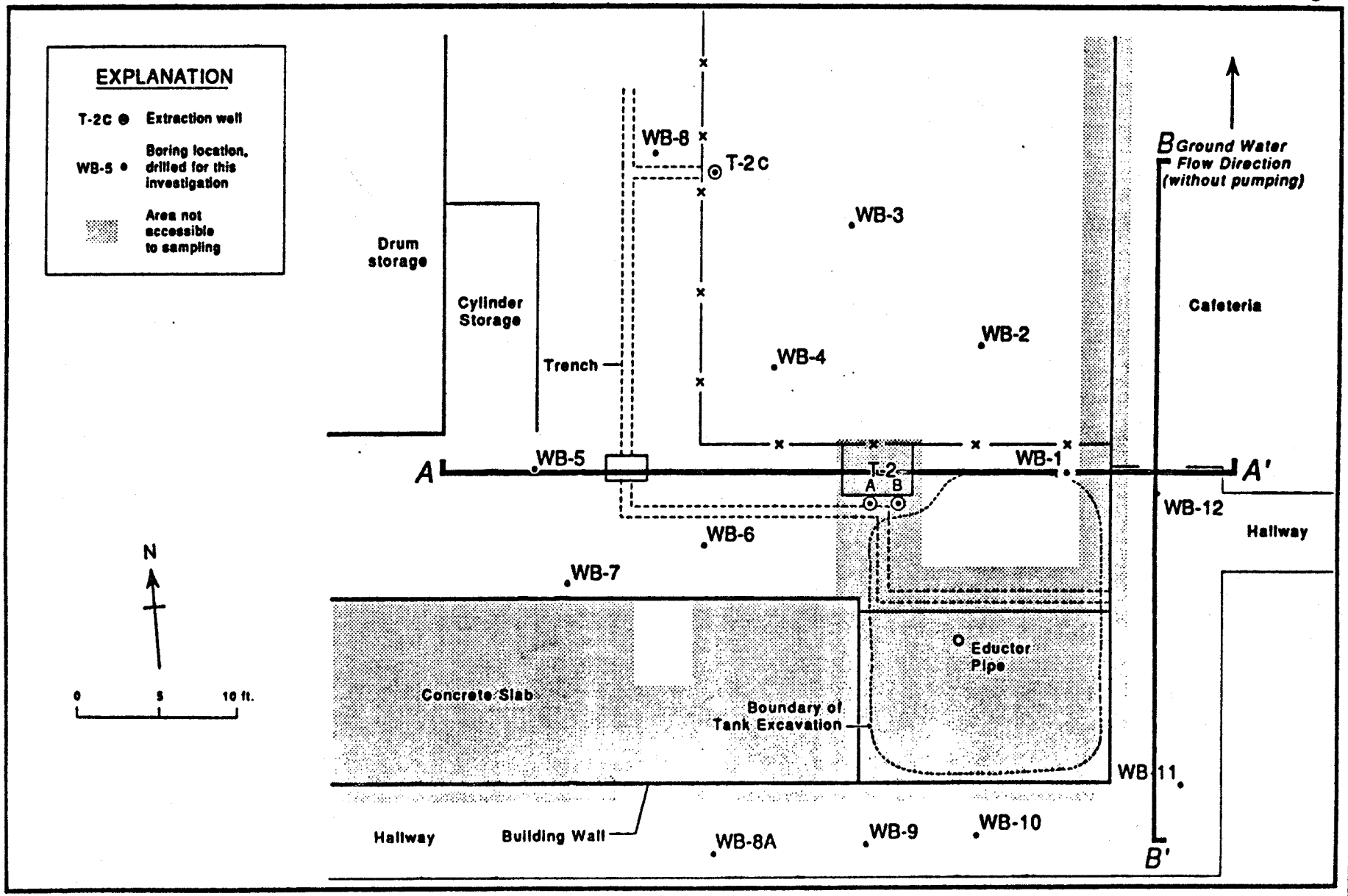

Figure 3. Location of Underground Tank Excavation, February 1988 Soil Borings and Cross Sections (from *Weiss Associates, 1988d*)

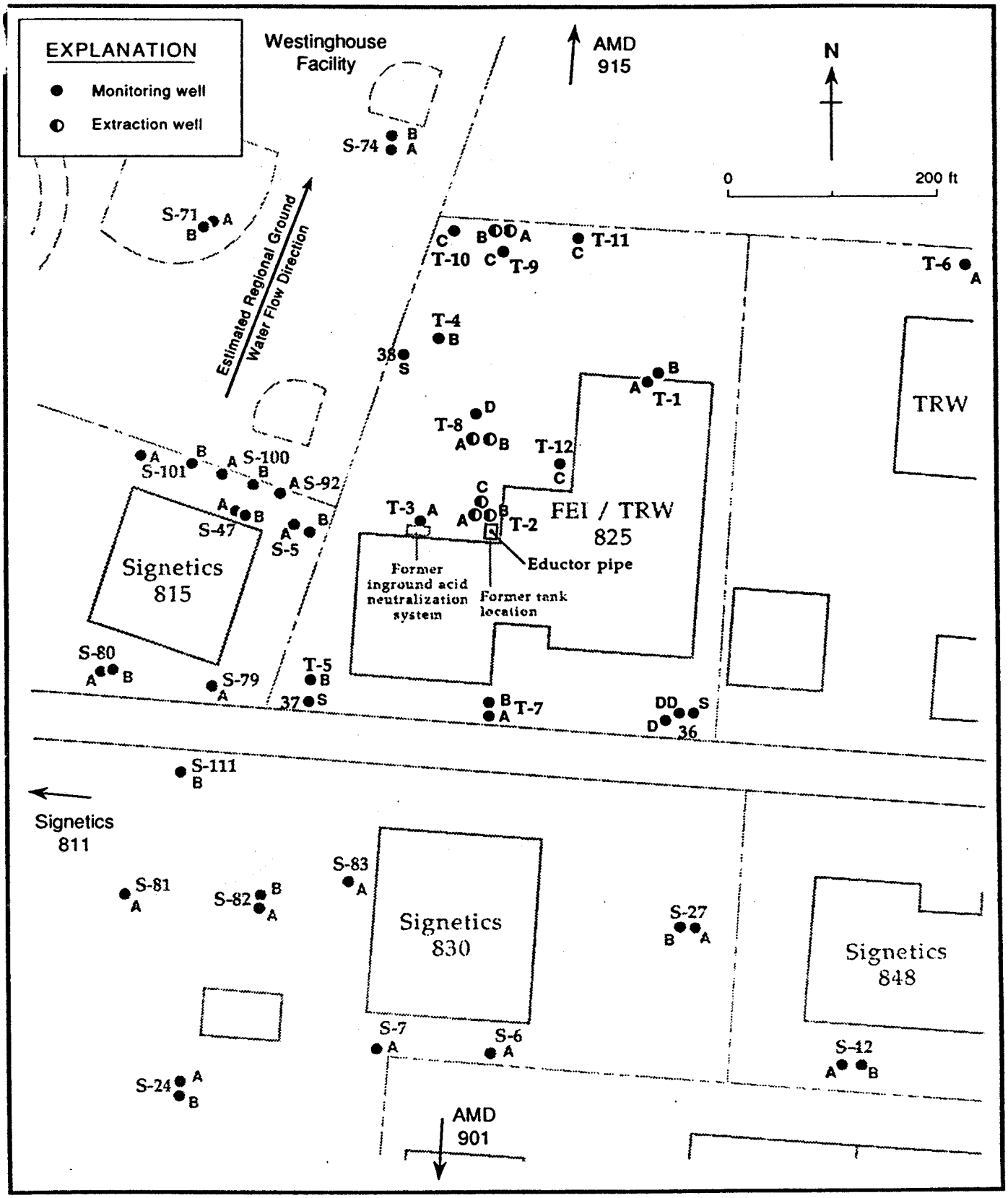

Figure 2. Monitoring and Extraction Well Locations - 825 Stewart Drive, Sunnyvale, California

APPENDIX 2

Table 1. Chemicals of Concern In Groundwater

Compound	EPA CARCINOGEN CLASS[a]	APPLICABLE OPERABLE UNITS
1,2- Dichlorobenzene	D	AMD, TRW
1,1-Dichloroethane	B2	ALL
1,1-Dichloroethylene	C	ALL
cis-1,2-Dichloroethylene	D	ALL
trans-1,2-Dichloroethylene	D	ALL
Freon 113	NA	ALL
Tetrachloroethylene	B2	AMD, TRW, Offsite
1,1,1-Trichloroethane	D	ALL
Trichloroethylene	B2	ALL
Vinyl Chloride	A	AMD, TRW, Signetics

(a) EPA Carcinogenicity weight of evidence:

A = known human carcinogen
B1 = probable human carcinogen, limited evidence of carcinogenicity from human studies, but for which there is sufficient evidence of carcinogenicity from animal studies
B2 = probable human carcinogen, inadequate evidence of carcinogenicity from human studies, but for which there is sufficient evidence of carcinogenicity from animal studies
C = possible human carcinogen, limited evidence of carcinogenicity from animal studies
D = not classified as to human carcinogenicity, inadequate human and animal evidence of carcinogenicity or for which no data are available
E = evidence of non-carcinogenicity in humans, no evidence of carcinogenicity in adequate human or animal studies

Table 2 – Evaluation of Remedial Action Alternatives for the TRW Operable Unit

Alternative	Protection of Human Health and Environment (1)	Compliance with ARARs	Long-term Effectiveness	Reduction of Toxicity, Mobility, or Volume	Short-term Effectiveness (2)	Implementability	Cost (Present Value) (3)
1 No further remedial action, monitoring only	May not be protective	Will require tens or hundreds of years	May not be effective	Long-term reduction of T,M and V	No increased exposure risk GCT = tens to hundreds of years	Implementable	$1.0 million
2 Existing ground water extraction system and deed restrictions (4)	Protective CR = 4E-5 HI = 0.1	Yes	Effective	Reduction of T,M and V	No increased exposure risk GCT, A = 7/11 years GCT, B = 6/9 years	Implementable	$0.8/$1.1 million
3 Soil flushing with existing ground water extraction system and deed restrictions	Protective CR = 4E-5 HI = 0.1	Yes	Effective	Reduction of T and V, M may increase	No increased exposure risk GCT, A = 7/11 years GCT, B = 6/9 years	Implementable	$0.8/$1.2 million
4 Soil Excavation with existing ground water extraction system and deed restrictions	Protective CR = 4E-5 HI = 0.1	Yes	Effective	Reduction of T,M and V	Excavation increases exposure risk GCT, A = 7/11 years GCT, B = 6/9 years	Very difficult to implement	$1.6/$2.0 million

Note: The preferred alternative is shaded.

(1) CR = Carcinogenic risk for domestic use of groundwater from combined A/B-aquifers; calculations include 1,1-dichloroethene and are for the average scenario.

(2) GCT,A = Groundwater cleanup times for the A-aquifer; years to clean up to remedial goals and to background.
GCT,B = Groundwater cleanup times for the B-aquifer; years to clean up to remedial goals and to background.

(3) Costs given for cleanup to remedial goals (first cost) and to background (second cost).

(4) Existing treatment system consists of air stripping of extracted groundwater.

Table 3 – Evaluation of Remedial Action Alternatives for the Offsite Operable Unit

Alternative	Protection of Human Health and Environment (1)	Compliance with ARARs	Long-term Effectiveness	Reduction of Toxicity, Mobility, or Volume	Short-term Effectiveness (2)	Implementability	Cost (Present Value) (3)
1 No Action	Not protective	Not for hundreds of years	Not effective	No reduction of T, M, V	Not effective	Implementable	$1.9 million
2 Expanded extraction; use of current treatment system (4)	Protective CR = 4E-5 HI = 0.2	Yes	Effective	Reduction of T, M, V	Effective GCT,A = 21/30 years GCT,B = 36/53 years	Implementable	$4.4/$4.9 million
3 Expanded extraction; treatment by carbon adsorption only	Protective CR = 4E-5 HI = 0.2	Yes	Effective	Reduction of T, M, V	Effective GCT,A = 21/30 years GCT,B = 36/53 years	Implementable	$10/$11 million

Note: The preferred alternative is shaded.

(1) CR = Carcinogenic risk for domestic use of groundwater from combined A/B-aquifers; calculations include 1,1-dichloroethene and are for the average scenario.

(2) GCT,A = Groundwater cleanup times for the A-aquifer; years to clean up to remedial goals and to background.
GCT,B = Groundwater cleanup times for the B-aquifer; years to clean up to remedial goals and to background.

(3) Costs given for cleanup to remedial goals (first cost) and to background (second cost).

(4) Existing treatment system consists of air stripping of extracted groundwater, followed by carbon treatment of the water.

TABLE 4
Cleanup Standards for the Chemicals of Concern In Groundwater

TRW, 825 STEWART DRIVE
Sunnyvale, California

COMPOUND	FEDERAL MCLG[a]	FEDERAL MCL[b]	CALIFORNIA MCL	APPLICABLE OPERABLE UNITS
1,2- Dichlorobenzene	(600)	(600)	NA	AMD, TRW
1,1-Dichloroethane[c]	NA	NA	5	ALL
1,1-Dichloroethene[d]	7	7	6	ALL
cis-1,2-Dichloroethene	(70)	(70)	6	ALL
trans-1,2-Dichloro-ethene	(100)	(100)	10	ALL
Freon 113	NA	NA	1,200	ALL
Tetrachloroethene[c]	(0)	(5)	5	AMD, TRW, OFFSITE
1,1,1-Trichloroethane	200	200	200	ALL
Trichloroethene[c]	0	5	5	ALL
Vinyl Chloride[c]	0	2	0.5	AMD, TRW, Signetics

(a) MCLG = maximum contaminant level goal. Concentrations in micrograms per liter.
(b) MCL = maximum contaminant level. Concentrations in micrograms per liter.
(c) Potential or probable human carcinogen.
(d) Possible human carcinogen.
NA = Not available.
( ) Criteria in parentheses are proposed standards